NUTRITIONAL AND MEDICAL IMPORTANCE OF CITRULLUS COLOCYNTHIS
- A REVIEW

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Abstract

For ages, plants are used for medication purpose to treat various disorders to improve health and wellness. Now a day, consumption of synthetic drugs has increased which further cause side effects and adversely affect health of the population. However, health consciousness and increase in knowledge about side effects of synthetic drugs tends to further enhancing the interest towards traditional medicines. Medicinal plants help to cure diseased condition for further improved living, so that importance of ‘ethno-medicine’ study was realized by population and more use of herb based medicines was come in demand for further use. India is a country with diversification in culture as well as in botanical geography. The use of botanical knowledge for medication of different ailments and diseases is the cohesive part of Indian rural population. *Citrullus colocynthis* is herbaceous plant packed with abundance of nutrients which plays key role in improvement of wellbeing. This is an underutilized and less known fruit crop of arid region. Almost all parts of such fruit crop used for health benefits. Seeds are rich source of oil and protein with superior fatty acid and amino acid profile. Other than nutrients, there are number of bioactive compounds such as cucurbitacin, flavonoids and polyphenols are present in *Citrullus colocynthis* which are further responsible for medicinal properties. Although, consumption of such plant is common in rural population but further investigations are required to improve the utilization of this super food.

**Keywords:** Citrullus colocynthis, medicinal plants, nutritional composition, bioactive compounds, flavonoids, health significance.

Introduction

For ages, plants are used for medication purpose to treat various disorders to improve health and wellness. Now a day, consumption of synthetic drugs has increased which further cause side effects and adversely affect health of the population. However, health consciousness and increase in knowledge about side effects of synthetic drugs tends to further enhancing the interest towards traditional medicines. Ethnobotany plays key role in gathering of the information related to different plant species with economic nature, nontoxic effect and beneficial for health improvement. As recent data shows that approximately 70% of the total population of India still have faith in herbs and herbs based traditional medicines. From ancient period, almost 2,500 species from about 1000 genera are getting used for medicinal purpose by traditional therapists (Chandal *et al.*, 1996; Kumar and Dwivedi, 2018a; Kumar *et al.*, 2018b; Kumar *et al.*, 2018c; Kumar and Dwivedi, 2018d; Kumar and Purnima *et al.*, 2018e; Kumar and Pathak, 2019f; Kumar and Siddique *et al.*, 2019g; Siddique and Kumar, 2018h; Siddique *et al.*, 2018i).

Medicinal plants help to cure diseased condition for further improved living, so that importance of ‘ethno-medicine’ study was realized by population and more use of herb based medicines was come in demand for further use (Singh, 1998) and improved the interest related to less-known and underutilized medicinal plants (Tripathi, 2000; Pathak *et al.*, 2017j; Prakash *et al.*, 2017k; Kumar and Mandal, 2014L; Kumar *et al.*, 2014m; Kumar and Dwivedi, 2014n; Kumar, 2013o; Kumar and Dwivedi, 2015p; Gogia *et al.*, 2014q; Kumar, 2014r; Kumar *et al.*, 2012s).

India is a country with diversification in culture as well as in botanical geography. Almost 7.5% tribal population is the part of Indian population out of which contains approximately 400 tribes and other cultural groups. The Indian locale, in this manner, is rich in ethnobotanical legacy. The Indian clans are exceptional, very proficient about the accessibility of a wide decent variety of plants and livestock present in their surroundings. These tribes are totally dependent on plant sources for variety of food, fibre, fodder, shelter and medicines. The use of botanical knowledge for medication of different ailments and diseases is the cohesive part of Indian rural population. Medicinal plants are natural resources with high potential which acquires an important position in spiritual as well socio-cultural criteria of tribal and rural population. On the basis of available data it is expected that in India, there are approximately 50% of the flowering species of the total used for medicinal production. Out of which around 25, 000 species are used for the traditional medicines in rural region of India whereas formulations prepared with the incorporation of medicinal plants using about 10,000 plant species are available in written form (Fulekar and Jadia, 2006).

*Citrullus colocynthis* is a fruit belongs to the ‘Cucurbitaceae’ family. It is considered extraordinary compared to other hereditarily various collections of remedial plants in the plant realm. Most of the plants from this family are dry season tolerant, bigoted to wet, ice touchy and inadequately depleted soils. The distribution of Cucurbitaceae family is mostly found in countries with tropical and subtropical regions (Dhakad *et al.*, 2017). *Citrullus colocynthis* commonly named colocynth, bitter-apple, wild-gourd etc., originated in tropical region of Asia and Africa is now extensively produce in Mediterranean region and Saharo-Arabian phyto-geographic region of Africa (Amamou *et al.*, 2011). *Citrullus colocynthis* is a perennial herb and in India most usually found in sandy lands of Northern West region such as Sind, Punjab, Central
region, Southern region and Coromandal costal area (Borhade et al., 2013).

The chemical composition plays vital role to determine the nutraceutical as well therapeutic properties of plant for further know the remedial effect. All of the medicinal plants contain number of bioactive compounds such as triterpenoids, steroids, alkaloids, tannins, flavonoids, essential oils, glycosides etc. which can produced by primary or secondary metabolism of living-being and further have direct effect on the physiological functions of human-being (Edogo et al., 2005). These compounds are extensively used in different areas related to medicines like in different therapies related to human and veterinary, for agriculture purpose, for revenue generation, for scientific researches etc. Other than bioactive compounds some nutritional composition is also present in medicinal plants which further help to improve nutritional status of the population (Vasu et al., 2009; Mishra et al., 2012; Kumar et al., 2011u; Kumar et al., 2011v; Kumar and Pathak, 2016w; Pathak et al., 2016x; Kumar et al., 2018y; Kumar et al., 2018z; Kumar et al., 2018aa; Kumar et al., 2018bb; Kumar et al., 2018cc; Singh et al., 2020a; Singh et al., 2020b; Sood et al., 2020; Bhadrecha et al., 2020; Singh et al., 2020c; Sharma et al., 2020; Singh et al., 2020d; Bhati et al., 2020; Singh et al., 2019; Sharma et al., 2019).

“According to National Research Council, (2006)’ the “moisture content of mature fruit” is recorded as 90% in Citrullus colocynthis as well it also contains high amount of protein at 30%, 10% of carbohydrates, 4% of ash content and 3% of fibre content. Other than these nutritional compounds different bioactive compounds are also present in this medicinal plant such as alkaloids, essential oils, flavonoids, glycosides etc. (Aviara et al., 2007). Citrullus colocynthis contains a specific bioactive compound named as cucurbitacins (A, B, C, D, E, I, J, K and L)’as well colocynthisides (A & B)’respectively (Hussain et al., 2014). For centuries, desert gourd is an important part of traditional Arabic medicines. On the basis of different studies, it has been reported that extract of root and callus part of Citrullus colocynthis contains anti-diabetic, anti-inflammatory, anti-oxidant as well as anti-cacinogenic properties (Gurudeeban, S. and Ramanathan, T., 2010; Rajamanickam et al., 2010; Gurudeeban et al., 2010). Although, Citrullus colocynthis is the widely grown fruit in arid regions with multiple medicinal and nutraceutical properties but still the fruit is less known and categorized as underutilized fruit crops. The present review enlightens the nutritional and medicinal properties of Citrullus colocynthis which can further help to increase the utilization of certain fruit crop in field of pharmacology.”

Origin

Citrullus colocynthis is a vine plant of arid region which grows in sandy soil. Basically the origin place of Citrullus colocynthis is Asia and Mediterranean Basin specially Turkey and Nubia which further distributed in western coastal region of Africa, Sahara, Egypt in eastern region, through India it also reaches to northern coastal region of Caspian seas and Mediterranean seas. The growth of Citrullus colocynthis has been also found in European countries located in south such as islands of the Grecian archipelago and Spain. Cultivation of Citrullus colocynthis at small scale is taking place from 14th century which today continues with export. This plant is perennial in nature with high survival rate under extreme adverse conditions. Further it has tolerance capacity for yearly ‘precipitation of 250 mm to 1500 mm’ whereas the optimal temperature for growth is considered at 14.8°C-27.8°C respectively. The growth of Citrullus colocynthis can takes place at 1500 meters above sea level at 5.0-7.8 pH in soil types such as sandy-loam soil, sandy soils of sea coast or soils of sub-desert area (Anonymous, 2012).

Plant Description

“Citrullus colocynthis is ‘herbaceous vine plant’ of arid region with perennial nature. The tendrils of plant are angular and rough in texture with prominent rough hairs and can be spread up to 3 meters of length. The plant has fleshy roots and can climb on other shrubs and herbs due to auxiliary tendency of branching tendrils. The structure of leaves includes 5-10cm of length, 1.5cm to 2cm of width with deeply lobed arranged alternatively on petioles are rough in texture (Savithramma et al., 2007; Amamou et al., 2011). The flowers are monocious, single, pale yellow in color with pedunculated shape and attached with the ‘axils of leaves.’ Each Citrullus colocynthis plant produces 15 to 30 fruits.’ The fruits of Citrullus colocynthis are round in shape with 7-10cm diameter, green in color with yellow bands which turns over all yellow after drying. It is smooth textured with globules and bitter in taste.” It contains rind part and seeds about 200-300 in numbers which are small in length i.e. approximately 6mm, smooth textured, compressed and turns brown in color after ripening (Schafferman et al., 1998). Further description is mentioned in Table1.

Table 1: Plant description of Citrullus colocynthis

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Magnoliophyta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division</td>
<td>Magnoliopsida</td>
</tr>
<tr>
<td>Class</td>
<td>Cucurbitales</td>
</tr>
<tr>
<td>Order</td>
<td>Cucurbitaceae</td>
</tr>
<tr>
<td>Family</td>
<td>Citrullus Scharl.</td>
</tr>
<tr>
<td>Genus</td>
<td>Citrullus colocynthis (L.) Schrad.</td>
</tr>
<tr>
<td>Species</td>
<td></td>
</tr>
</tbody>
</table>
Nutritional composition of Citrullus colocynthis

Although *Citrullus colocynthis* is the widely grown but less known underutilized fruit crop of arid region, it contains certain important nutrients which can be further utilized and can play key role to enhance nutritional status of the population. All of the parts of *Citrullus colocynthis* having utility and can further improve the health of individuals. The moisture content of the fresh mature fruit was estimated at 90% of the total weight of fruit. Variation in agro-ecological conditions as well agricultural practices can affect the nutritional composition of such plant and its parts (Aviara *et al.*, 2007).

“As per data provided by ‘National Research Council, (2006)’ seed kernel of *Citrullus colocynthis* are rich source of oil and contains about 50% of oil content whereas other nutrients such as ‘protein, ‘carbohydrate, ‘ash, ‘fibre’ etc. are present in amount of 30%, 10%, 4% and 3% respectively. The yield of oil content present in seeds of this respective fruit crop is equivalent to oil yield from oilseeds (sunflower and safflower) which was comparatively higher than the oil production from soyabean and cotton seeds (Sadou *et al.*, 2007). As per mentioned in literature, the oil extracted from *Citrullus colocynthis* seeds is It has been reported in the literature that the oil extracted from *Citrullus colocynthis* seeds is possibly appropriate for livestock as well as for human consumption (Sawaya *et al.*, 1983). Other than high oil content *Citrullus colocynthis* seeds were rich source of protein and contain all essential amino acids in appropriate amount which makes the protein quality of *Citrullus colocynthis* seeds superior and equally important as legumes (National Research Council, 2006).”

Fatty acids

As per the available data, the oil content of Citrullus colocynthis seeds reported as higher than some of the oilseeds. The *Citrullus colocynthis* seed oil contains two major Saturated Fatty Acids (SFAs) as palmitic acid and stearic acid within the range of 8.1%-17.3% and 6.1%-10.5% respectively (Sawaya *et al.*, 1983; Sadou *et al.*, 2007; Sebbagh *et al.*, 2009). Whereas oleic acid and linoleic acid were majorly present Mono Unsaturated Fatty Acids (MUFA) in respective oil. The content of linoleic acid was present in range of 50.6%-60.1% which was quit higher than other oils and makes the oil medicinally superior than other oils. Due to the presence of linoleic acid and oleic acid in *Citrullus colocynthis* seed oil it categorized under linoleic-oleic acidoils and considered as equivalent to various other vegetable oils (Sadou *et al.*, 2007; Sebbagh *et al.*, 2009). On the basis of fatty acid composition and chemical composition of this seed oil its estimated as the considerable source of β-carotene, α-tocopherol and γ-tocopherol at 0.18mg/kg, 45.1mg/kg and 43.5 mg/kg respectively (Kalhoro *et al.*, 2002).

Amino Acids

As similar as fatty acid composition *Citrullus colocynthis* seeds are considerable sources of protein with the higher content of essential amino acids such as methionine, arginine and tryptophan etc. (National Research Council, 2006). The protein quality was estimated as lower than soya protein but considerably higher than other oilseed proteins. Lysine and threonine were reported as limiting amino acids in such oil. In a study the amino acid composition of *Citrullus colocynthis* seed protein was compared with other oilseeds protein and found that glutamic acid and arginine were majorly present in seed oil with certain concentration at 19.8 g/100g of protein and 15.9g/ 100g of protein respectively. Some other amino acids were also found in kernel seed protein such as glycine, alanine, leucine, aspartic acid, serine, glycine, and phenylalanine etc. (Sawaya *et al.*, 1986).

Minerals

The mineral content was also present in abundance in *Citrullus colocynthis* fruit and seeds. *Citrullus colocynthis* seed was considered as potential source of calcium as well as potassium and present in concentration at 569mg/100g and
forms of isovitexin, isosaponarin and isoorientin along with cucurbitacin glycosides such as 2-O-β-D-glucopyranosyl (cucurbitacin L) and 2-O-β-D-glucopyranosyl (cucurbitacin I) whereas commonly present flavonoids in Citrullus colocynthis fruit were reported as catechin, quercetin, kaempferol and myricetin respectively (Delazar et al., 2006).

Other than flavonoids Citrullus colocynthis also contains phenolic compounds which further acts as antioxidants. Almost eight kind of phenols were observed in Citrullus colocynthis i.e. caffeic acid, chlorogenic acid, sinapic acid, ferulic acid, gallic acid, p-hydroxy- benzoic acid, p-Coumeric acid and vanillin (Hussain et al., 2013).

Alkaloids

Some of the studies reported that Citrullus colocynthis fruit contains alkaloids in form of choline and some unidentified alkaloids which further need to investigate (Ali et al., 2013).

Medicinal Importance of Citrullus colocynthis

On the basis of various investigations it has observed that Citrullus colocynthis is a fruit with abundance of essential nutrients which can further use in formulation of drugs to improve health status as well as can combat the nutritional deficiencies. Due to the presence of plenty of bioactive compounds Citrullus colocynthis contains pharmacological properties which can further helps in improvement of diseased conditions. These bioactive compounds have various health effects such as anti-inflammatory, anti-diabetic, anti-microbial, anti-bacterial, anti-carcinogenic, anti-ulcerogenic along with hypolipidemic and hypoglycemic and also perform anti-oxidant activity. Various health effects associated with different bioactive compounds are presented in Table 2.

Table 2: Bioactive compounds and their health significance.

<table>
<thead>
<tr>
<th>Plant part</th>
<th>Extract</th>
<th>Bioactive Compound</th>
<th>Health significance</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit pulp</td>
<td>Methanolic Extract</td>
<td>Cucurbitacin, L- tocopherol, Phenolic compounds</td>
<td>Promotes wound contraction</td>
<td>Gupta et al., 2012</td>
</tr>
<tr>
<td>Stem</td>
<td>Callus Extract</td>
<td>Silver nanoparticles, Polyphenols</td>
<td>Anti-bacterial effect, Anti-Inflammatory activity</td>
<td>Sanyavani et al., 2011</td>
</tr>
<tr>
<td>Fruit pulp</td>
<td>Methanolic Extract</td>
<td>Antioxidants, Phenols</td>
<td>Anti-oxidant activity, Free radical scavenging activity</td>
<td>Kumar et al., 2008</td>
</tr>
<tr>
<td>Fruit</td>
<td>Powder other Extract</td>
<td>Flavanoids</td>
<td>Anti-Antispasm effect</td>
<td>Dhingra et al., 2011</td>
</tr>
<tr>
<td>Seed</td>
<td>Hydro-Methanol Extract</td>
<td>Sapogenins</td>
<td>Anti-Hypertensive effect</td>
<td>Zaman et al., 2007</td>
</tr>
<tr>
<td>Root</td>
<td>Aqueous Extract</td>
<td>Glycosides, Flavonoids, Alkaloids</td>
<td>Hypoglycemic Activity</td>
<td>Agrawal et al., 2012</td>
</tr>
<tr>
<td>Leaves</td>
<td>Chloroform glucoside Extract</td>
<td>Flavonoids (Apigenin, Quercetin, Naringin and Luteolin)</td>
<td>Inhibit growth of breast cancer cells</td>
<td>Tamam-Spie et al., 2007</td>
</tr>
<tr>
<td>Leaves</td>
<td>Methanolic Extract</td>
<td>Flavonoids</td>
<td>Anti-Inflammatory activity</td>
<td>Rajamanickam et al., 2010</td>
</tr>
<tr>
<td>Fruit pulp</td>
<td>Petroleum other Extract</td>
<td>Sapogenins, Flavonoids, and Glycosides</td>
<td>Anti-Diabetic effect</td>
<td>Jayaraman E et al., 2009</td>
</tr>
<tr>
<td>Seed</td>
<td>Methanolic</td>
<td>Anti-Oxidants</td>
<td>Anti-Carcinogenic</td>
<td>Qai et al., 2011</td>
</tr>
</tbody>
</table>
Although various significant studies have conducted and analyzed the significant effect of *Citrullus colocynthis* on health improvement but still more investigations are required related to this super fruit. Use of different parts of such plant is common in rural population and they use it in traditional remedies for treatment of different diseased conditions and for further health benefits. However, the substances responsible for these medicinal properties are unknown but it helps to improve wellness. According to Meena *et al.* (2014) some of the traditional remedies used by rural population are:

- Pulverized form of fruit part stuffed with carom seeds and salt treats Dyspepsia.
- Consumption of decoction of fruit helps to relief in Constipation.
- Paste of root helps to heal open wound.
- Application of paste prepared by root part helps to treat Paronychia.
- Seed oil helps to treat alopecia and premature greying.
- Consumption of fruit with Aswagandha helps in treatment of Rheumatism.
- Decoction of fruit helps to promote Lactation.
- Consumption of fruit with combination of carom seeds helps to recover in Jaundice.
- Consumption of root paste helps in haemorrhoid condition.

**Conclusion**

In the present review the nutritional composition and medicinal properties of *Citrullus colocynthis* has discussed with incorporation of different relevant studies. On the basis of this overview it can be analyzed that *Citrullus colocynthis* is a fruit crop with number of health benefits and which can further help in formation of different drugs to treat various disorders. Although, it is a fruit crop with abundance of nutritional significance but it is still unfamiliar for the huge population. So further investigations are required to enhance the utility of such fruit crop and can use as functional food for further improvement in health of individuals.

**References**


derived callus extract of bitter apple (*Citrullus colocynthis*). Digest J. Nanomaterials and Biostructures, 6(3): 1019–1024.


